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VOL. 15, NO. 3

NOTES

JULY 1970

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FOREST SERVICE — U. S. DEPARTMENT OF AGRICULTURE
INTERMOUNTAIN REGION — OGDEN, UTAH

STATEMENT OF PURPOSE

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Experimental Top Pruning of Curl-Leaf Mahogany Trees
On the South Horn Mountain
Ferron Ranger District - Manti-LaSal National Forest

By

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* * * * *

Extensive stands of mature and over-mature curl-leaf mahogany (Cercocarpus ledifolius) occur on the Manti-LaSal National Forest. These stands occur within big game key wintering areas. In their present condition, these trees provide very little available browse to wintering big game.

There is a critical need for additional big game winter browse and any method of increasing or improving the availability of existing browse needs some investigation. Many methods of improving browse are known but very few have been tried in these dense stands of curl-leaf mahogany.

Root and stump sprouting has been observed to take place on many species of shrubs and trees after mechanical and chemical treatment. Response to top pruning is also known for many species of shrubs and trees. Some work has been done with curl-leaf mahogany but no published information has been found on root and stump sprouting or response of this species to top pruning.

A large stand of curl-leaf mahogany occurs in a band along the east rim of the Horn Mountain, Emery County, Utah (Ferron Ranger District). This band varies from a few chains to almost a mile wide and extends approximately ten miles from Mahogany Point on the north to South Point on the south. Small islands of mahogany trees are scattered in various other drainages of the Horn Mountain and the Manti-LaSal National Forest.

On South Horn Mountain, curl-leaf mahogany occurs at about the 8,000-foot elevation level and occupies mostly the south and west facing slopes. Annual precipitation averages 14-16 inches, and comes mostly during the winter months (October-April) as snow. Summer thunderstorms occur during July and August and amount to about one-fourth to one-third the annual precipitation.

Soils within these mahogany stands are mostly derived from the North Horn and Price River formation. They are low in fertility, shallow (0-24 inches deep) and sandy to sandy loam texture. Profiles are poorly developed and structure is loose and erosive. Leaves and other organic materials accumulating near the base of the trees breaks down slowly and adds little to the soil composition.



Objectives of Study

1. To determine if top pruning curl-leaf mahogany trees will increase available browse.
2. What season is best for top pruning.
3. Which tree size or age class responds best to pruning.
4. What effect the pruning has on seedling establishment and survival.

Study Procedure

In May 1963, three 1-chain-square pilot plots were established in a dense stand of mahogany trees near the east rim on the South Horn Mountain. In September 1964 a 1-acre plot was pruned and in November 1964 another 1-acre plot was pruned in the same general area.

On each pruned plot all curl-leaf mahogany trees were counted by age class. Trees were classed as young, mature, and old. Young trees are trees less than four feet tall - no evidence of seed production. Mature trees are trees more than four feet tall but less than fifteen feet - stem diameter is less than five inches, and dead limbs less than ten percent of crown. Old trees are trees with stem diameter of more than five inches, or dead limbs make up more than ten percent of the crown. Data on which age class or tree size responds best to top pruning was obtained from measurement and counts on the spring and fall pruned plots (Table 2).

All trees were heavily pruned. Only one or two live branches were left on each stump. Several live branches were selected on each pruned plot and tagged (Photograph No. 1). The current annual growth of each branch above the tag was measured to the nearest half inch each fall (October).

Several live branches from the unpruned control plot, established adjacent each pruned study plot, were tagged and current annual growth was recorded.

The number of seedlings per square foot was obtained from strip plots, 1 ft. x 100 ft. established in all pruned and control plots.

General view photos of plots before and after pruning were taken. Photos of several tagged branches were also taken (See Appendix).

Results and Discussion

Observations and measurements were made of the pruned trees for five growing seasons following treatment.





No. 1 - View of over-mature mahogany trees before pruning.
Note density of tops and numerous dead limbs.



Over-mature mahogany trees immediately after spring pruning.
Note size of limbs cut. Height to first small branches is about 4 feet - nearly out of reach of any browsing big game animals.

Limb growth on the spring pruned plots increased from less than one-half inch annual growth before pruning to an average of 2.8 inches annual growth after pruning (Table 1). During the first three seasons following pruning, growth averaged 3.2 inches but during the next two seasons, only 2.2 inches average growth was produced. This sudden slowing down of growth may be partially explained by (1) the pruned branches becoming so dense with new limbs that crowding and lack of light reduced growth; (2) less precipitation was noted to occur during the fourth growing season and the spring of the fifth growing season was cold and late; (3) reversion of the plant back to its original sporadic growth habit similar to what it was before pruning; (4) pruned limbs began producing seed during the fourth growing season and more limbs produced seed during the fifth growing season. Growth on limbs which produce seed is noticeably less than on those which produce no seed. Some branches which produced a heavy seed crop did not have any current growth.

Table 1 - Average inches limb growth on spring, fall, and winter top-pruned curl-leaf mahogany tree plots

Growing Season	Spring pruned plots		Fall pruned plots		Winter pruned plots	
	Pruned	Control	Pruned	Control	Pruned	Control
1	3.2	0.3	2.4	0	3.1	0.3
2	3.2	0.4	1.4	0.4	*Dead	0.2
3	3.3	1.9	3.1	0	*Dead	0.5
4	2.7	1.2	1.4	0	*Dead	0.5
5	1.8	0.8	3.2	0	*Dead	0
Total	14.2	4.1	11.5	0.4	3.1	1.5
Average	2.8	0.9	2.3	0.1	0	0.3

Av. new growth +1.9"

+2.2"

*No pruned trees survived beyond the first growing season.

Trees pruned during the spring bleed sap heavily. Bleeding soon stops in the smaller trees (less than 5-inch diameter); however, some bleeding in the smaller stems was noted in the fall of the first season. This bleeding does not seem to retard the re-growth on the smaller trees but the larger trees (6-8-inch diameter class) never seem to stop and usually do not live beyond the second or third growing season. While most of these large trees are alive they do produce some re-growth. No bleeding of sap was observed from the fall or winter pruned plots.

Trees on the fall pruned plot showed a 2.3-inch average annual growth for the five growing seasons of study (Table 1). Annual growth of the fall pruned branches is much more variable than on the spring pruned branches. Fall pruned branches show a good growth one season and poor the next. Many of the pruned branches died the second growing season after pruning. Six of

the twenty tagged branches died the second growing season. It was observed that the general health and condition of the fall pruned trees was poor the first and second growing seasons. Better growth was made during the third season and seed was produced the fourth.

Trees pruned during the winter (November-December) nearly all died before the end of the first growing season. The trees which survived had an average growth of 3.1 inches for the first season. These trees died before the end of the next growing season (Table 1).

Table 2 - Number of curl-leaf mahogany trees on the spring, fall, and winter top-pruned plots before and five seasons after pruning.

Age Class Trees	No. Spring Pruned			No. Fall Pruned			No. Winter Pruned		
	Before	After	%Loss	Before	After	%Loss	Before	After	%Loss
Young	14	14	0	8	8	0	1	0	100
Mature	110	107	2.7	43	35	18.6	15	0	100
Old	44	34	22.6	7	0	100	17	0	100
Total	168	155	7.7	58	43	34.9	33	-	100

The effect of top pruning on the different age classes is summarized in Table 2. It shows that the younger age classes can be top pruned without loss in the spring and fall. Three mature trees died on the spring pruned plots for a 2.7 percent loss. On the fall pruned plot, eight mature trees died for 18.6 percent loss. Ten old trees were lost on the spring pruned plots for 22.6 percent loss, and seven on the fall for a 100 percent loss. A total of thirteen trees died on the spring pruned plot for a 7.7 percent loss of pruned trees. On the fall pruned plot fifteen trees died for a 34.9 percent loss. All age classes pruned on the winter pruned plot died. Spring pruning has resulted in fewer losses in all age classes.

Data on which age class or tree size responds best to top pruning was obtained from the three spring pruned study plots. Study Plot No. 1 was located in a very dense, old, overmature stand of trees in which 97.5 percent of the trees were classed as old. Study Plot No. 2 was located in a younger and smaller class of trees in which 93.6 percent of the trees were classed as mature trees. Study Plot No. 3 is located on the edge of a canyon and contains a mixture of all age classes.

Table 3 - No. and percent composition of curl-leaf mahogany trees by age classes on the three spring pruned study plots

Plot	Young		Mature		Old		Total
	No.	Percent	No.	Percent	No.	Percent	
1	0	0	1	2.7	36	97.3	37
2	1	1.7	59	93.6	3	4.7	63
3	13	19.1	50	73.5	5	7.4	68
Totals	14	8.3	110	65.5	44	26.2	168



Average inches of limb growth for the spring pruned plots for the five seasons of study were as follows: Plot No. 1 - 2.7 inches; Plot No. 2 - 3.1 inches; Plot No. 3 - 2.7 inches (Table 4). Limb growth was better on Study Plot No. 2 than on the other two study plots. Trees on this plot were of the small mature class, stems mostly in the 2-4 inch diameter class, and tree heights ranged between 8-12 feet tall. Regrowth resulting from top pruning mature (2-4 inch diameter class) and younger class of trees is thick and dense. The volume of available browse produced by these tree classes is also greater than was produced by the old tree class.

Table 4 - Average inches annual limb growth of curl-leaf mahogany trees on the three spring pruned and control study plots.

Growing Season	Plot No. 1		Plot No. 2		Plot No. 3	
	Pruned	Control	Pruned	Control	Pruned	Control
1	3.3	0.2	3.3	0.2	2.9	0.1
2	2.9	0.6	3.6	0	3.0	0.7
3	3.2	1.7	3.2	2.2	3.5	1.9
4	2.2	0.8	3.2	1.2	2.5	1.5
5	2.0	1.0	2.1	0.8	1.4	0.6
Total	13.6	4.3	15.4	4.4	13.3	4.8
Average	2.7	0.8	3.1	0.9	2.7	0.9

A large crop of curl-leaf mahogany seed was produced the second growing season after pruning. This resulted in a good crop of mahogany seedlings the following season.

Seedlings on the spring pruned plot averaged 1.72 per square foot and 2.49 per square foot on the control plots the first fall after establishment (Table 5). The fall pruned plots had 4.41 seedlings per square foot for the pruned plot and "0" on the control plot the first fall after pruning. Seedlings did become established the next season on the fall control plot but had died out two seasons later. No seedlings have become established within the strip plots on the winter pruned plots. However, a few seedlings have become established in the area surrounding the strip plots.

At the end of the fifth growing season, only 0.16 seedlings per square foot remained alive on the spring pruned plot. This is a 9.3 percent survival (Table 5). On the unpruned control plot 1.6 percent survived. The fall pruned plot, at the end of the fifth growing season, had 1.75 seedlings per sq.ft. for an 8.6 percent survival. Survival of the seedlings on the spring and fall pruned plots is nearly the same, indicating pruning can increase seedling establishment rates.

The number of seedlings on the spring pruned plots, 0.16 seedlings per square foot, is equal to 6969 seedlings per acre. Data collected on tree



density shows that a well stocked mahogany stand in this area contains an average of 460 mature trees per acre. This indicates that the pruned sites are well stocked with seedlings.

Table 5 - Curl-leaf mahogany seedlings per square foot on the spring and fall pruned study plots. (1' x 100' strip plots)

Growing Season	Spring Pruned Plot		Fall Pruned Plot	
	Pruned	Control	Pruned	Control
1	1.72	2.49	4.41	0
2	0.54	1.07	3.26	1.33
3	0.29	0.45	0.56	0.48
4	0.22	0.15	0.38	0
5	0.16	0.04	0.38	0
Total	2.93	4.20	8.99	1.81
Average	0.59	0.84	1.75	0.36
% Survival	9.3	1.6	8.6	0

Many seedlings observed growing in the control site were in small bunches, 3-10 inches in diameter, and growing in the deep duff and litter accumulation under the old trees. By the end of the second growing season, few of these bunches had any live seedlings in them. It was observed that very few of the roots of these seedlings penetrated through the litter or duff layer into the soil below. This condition was very pronounced with those seedlings found growing in litter accumulation of more than five inches depth. Those seedlings growing in litter accumulation of less than four inches had little trouble getting roots into the soil below.

Seedlings dug from the deep litter accumulation had many lateral roots but no central taproot; whereas those from the open and shallow litter accumulation have a strong well developed tap or central root system with only a few root hairs in the top two inches below the crown.

Seedlings found in the pruned plots are mostly established in the shallow litter accumulation under the pruned trees. Very few have become established in the open mineral soil. These seedlings, mostly 4-5 years old, average 4-6 inches in height and have secondary branches. Some seedlings growing under slash piles have new leader growth of up to 10 inches for a growing season. Seedlings growing in the control areas average about 2 inches in height; have no secondary branches, only a small terminal rosette of leaves; and seem to be just hanging on.

At the beginning of this study, seedlings that tried to become established in the deep litter accumulation all died. These litter accumulations had only been exposed one growing season. After these litter accumulations have



been exposed for five growing seasons, some seedlings are becoming established in them. These seedlings have a well developed central root. Litter accumulation, before it is exposed, is very loose and unconsolidated with many mahogany leaves still not broken down. After being exposed, these leaves begin to decompose and form a more consolidated mat.

Another observation on the rate these deep litter accumulations break down is that no vegetation became established on them except mahogany seedlings until the third growing season after they had been exposed. A good cover of annual weeds, (Chenopodium) became established then, followed the next season by a few annual and biennial woods and grasses.

Understory vegetation has responded very slowly to the removal of the overstory cover. Hard grass (Elymus simplex), Indian ricegrass (Oryzopsis hymenoides), and blue grama (Bouteloua gracilis) have increased some in density on all pruned plots except the fall pruned plot. This plot had very little understory vegetative cover before it was pruned. Big sagebrush (Artemisia tridentata) has increased top growth on most old plants but no new seedlings have been found on any plots.

CONCLUSIONS

1. From results and observations made during the five growing seasons of study of top pruned mahogany trees (Cercocarpus ledifolius) it was found that they can be successfully top pruned to increase available browse.
2. Top pruned trees averaged 2.8 inches annual growth on spring pruned plots and 2.2 inches annual growth on early fall pruned plots. This is about 200 percent increased growth over unpruned trees.
3. Best results from top pruning are obtained when:
 - (a) At least one live pruned branch is left on each pruned tree. Mahogany produces all its new limbs from terminal growth of spurs or existing branches. No new branches were found coming from the old stumps below growing limbs, indicating there apparently are no adventitious buds below their growing limbs or spurs.
 - (b) Pruning is done in spring (April 20-May 10) or fall (September 10-30). Late fall or winter pruning (November-January) resulted in a complete loss of all pruned trees.
 - (c) The smaller branches are also pruned. All heavily pruned small branches produced more regrowth than similar small branches left unpruned.

- (d) The smaller mature and younger trees are pruned. Trees with stem size 2 to 4-inch diameter and less than 12 feet tall are the easiest to prune, give better regrowth, and fewer die from pruning. Large overmature trees are very difficult to prune and have fewer branches suitable for pruning. They also bleed heavily when pruned and many die soon after pruning.
4. There was a slowing down of twig growth on the spring pruned plots after the third growing season. However, growth still exceeded that of unpruned trees.
 5. Seedlings found growing on the pruned plots are mostly established in the shallow litter accumulation of less than 4 inches depth. However, after five growing seasons of exposure, these deep litter accumulations are breaking down and seedlings are becoming established in them.
 6. Seedlings 4 to 5 years old average 4 to 6 inches in height. Some have secondary branches. They are not providing much available browse yet.
 7. On the spring pruned plots seedling average is 0.16 per square foot. This is 6969 seedlings per acre. A well stocked mahogany site in this area averages 460 mature trees per acre.
 8. Large scale top pruning of curl-leaf mahogany stands is not recommended at this time. Pruning smaller selected sites (1-to 2-acre size) which have the small mature age class of trees can result in an increased browse production. Pruning selected sites on critical big game winter range could increase browse production but would not change the general aspect of the type or reduce substantially the essential big game cover.
 9. Top pruning curl-leaf mahogany trees is expensive work. Data kept on this experimental work shows that a man could prune about two acres per work day with a chain saw on selected sites. These costs compare favorably with other game range improvement projects done in the Horn Mountain area. These projects are the Biddlecome Ridge pinyon-juniper chaining project and Joe's Valley selective pinyon-juniper removal project.

Top pruning curl-leaf mahogany on selected site basis should be considered as a method for increasing available browse on big game winter range.

* * * * *

Whatever you do - do it SAFELY



No. 2 - Spring pruned limb on an old age class tree. Annual growth has been less than one-half inch for many years. Photo taken immediately after limb was pruned.



Five growing seasons after this limb was pruned. This limb is growing an average of 3.0 inches annually.





No. 3 - Tagged branch on a spring pruned mature age class tree.
End of fifth growing season - this branch is growing an
average of 4.9 inches annually.



No. 4 - Tagged branch on a spring pruned mature age class tree.
Photo taken at end of fifth growing season. Branch is
growing 4.9 inches annually.





No. 5 - Tagged branch on a fall pruned mature age class tree.
Photo taken immediately after branch was heavily pruned.



Five growing seasons after pruning - branch is growing an average of 2.3 inches per season.

